C-5.1 Explain the effects of the intermolecular forces on the different phases of matter.

Revised Taxonomy Levels 2.7 B <u>Explain</u> conceptual knowledge

Students did not address this concept in physical science

It is essential for students to

- Diagram, describe, and give examples of the following intermolecular forces
  - Dipole-dipole attraction
    - Hydrogen bonding
  - London dispersion forces
- Compare intermolecular forces (dipole-dipole interaction, and London dispersion forces) and ionic bonds, covalent bonds, and metallic bonds in terms of
  - Nature of the attraction
  - type of substance
  - structural unit
  - examples
  - typical properties

Type of Substance	Structural Unit	Inter-particle Force	Substance	Melting Point (1atm, ˚C)	Boiling Point (1atm, ˚C)
Non-polar Covalent (molecular)	molecule	London Dispersion Forces	H_2	-259	-253
			O_2	-218	-183
			CH_4	-182	-164
			CCl_4	-23	77
			C_6H_6	6	80
Polar Covalent (molecular)	molecule	Dipole-dipole interaction	H_2O	0	100
			H_2S		-61
			HCl		-85
			NH_3	-78	-33
Ionic	ion	Ionic bonds	NaCl	801	1413
			MgF_2	1266	2239
Metallic	atom	Metallic bonding	Cu	1083	2567
			Fe	1535	2750
			Hg	-39	357
			W	3410	5660
Covalent Network	atom	Covalent bonds	$(SiO_6)_x$	1610	2230
			C_x (diamond)	3500	3930

- Use a chart, such as the one above to compare the intermolecular forces present in substances with high, low, and moderate melting and boiling points.

- Discuss other factors, (in addition to the nature of the intermolecular force) which affect the melting and boiling point of a substance.

Assessment

The verb, explain means that the major focus of assessment should be for students to "construct a cause and effect model". In this case, assessments will ensure that students can model how intermolecular forces influence the melting point and boiling point of various types of substance. Because the indicator is written as conceptual knowledge, assessments should require that students understand the "interrelationships among the basic elements within a larger structure that enable them to function together." In this case, assessments must show that students can construct a cause and effect statement relating how the intermolecular forces, in the context of other factors, determine the properties of a substance.